PLATE GLASS

PLATE GLASS MANUFACTURERS
OF AMERICA

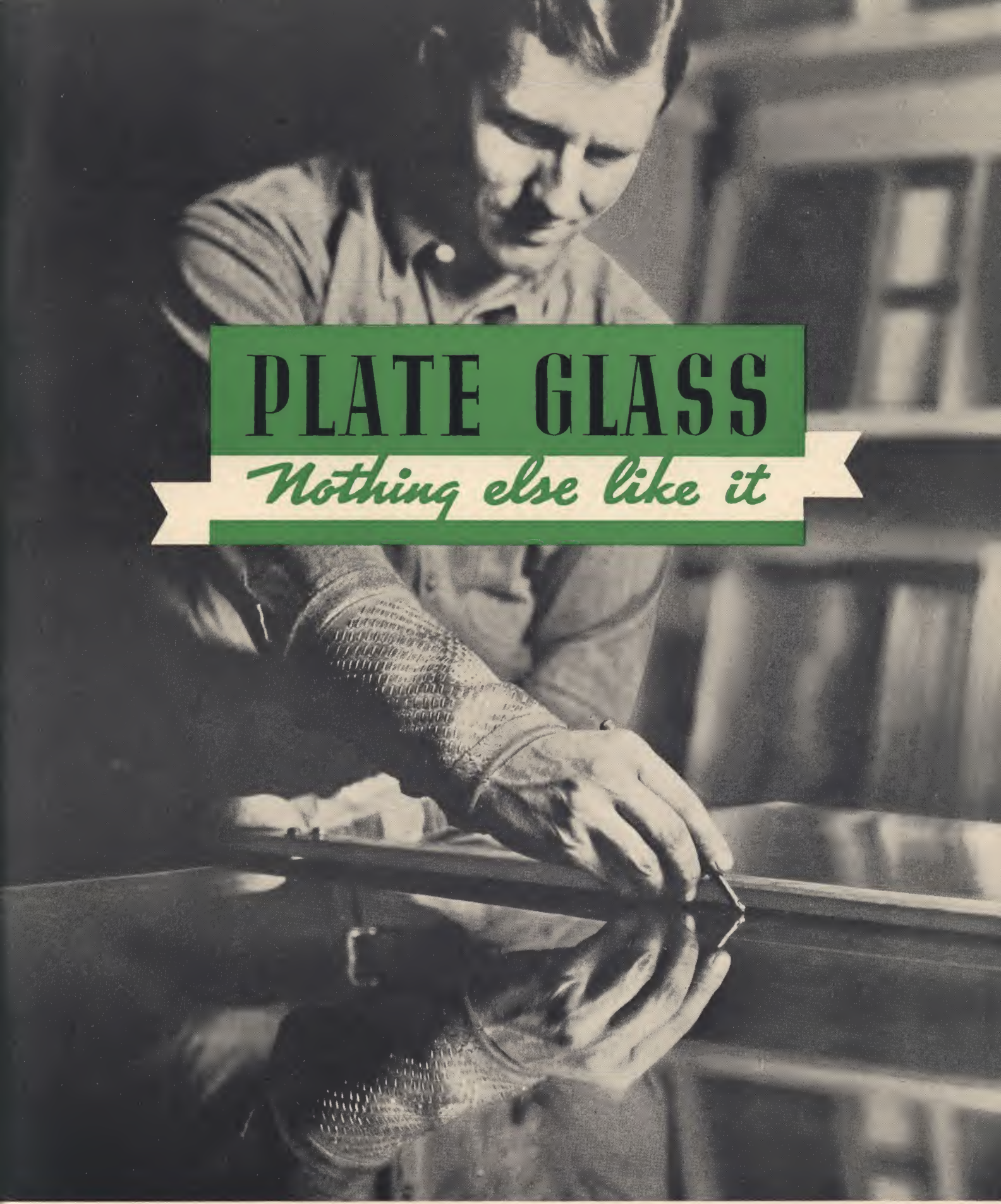


PLATE GLASS
Nothing else like it

GLASS THROUGH THE AGES

GLASS! A simple word of five letters . . . and yet in that single word is wrapped up as much romance, heart-break, courage, heroism, sacrifice and glorious success as in any other word in industrial history!

Glass! Its life story was, for many, many centuries, a fragile, tangled, broken thread . . . a thread without any known beginning, difficult to follow, and apparently leading nowhere. When was glass first used by man on this earth of ours? Who discovered glass, or invented it? How did its use spread from its original geographical home to other parts of the world? We do not know.

In fact, trying to trace the origin and development of glass, for its first forty-five centuries of existence, is like trying to trace a will-o-the-wisp. We get but brief, vague glimpses of it, glimpses separated often by centuries of time, by thousands of miles of space. We find a rumor of glass in ancient Phoenicia. Then it bobs from sight, to reappear uncertainly in Egypt, thousands of years before the Christian era. This momentary glimpse winks out, and oblivion enfolds the progress of glass, until, perhaps in ancient Assyria, glass bobs up again. Rome—the mighty Rome of the Caesars—provides some scanty evidence that it knew glass. How did it get there? Who brought it? The answers to these questions are obscured by the fogs of history.

But one thing we do know about the glass of these early peoples. It was used largely for its art and decorative value . . . in flagons, vases, colored ornamental lumps . . . and not as a material with any practical usefulness. So when you hold a piece of glass before your eyes today, and look through its marvelous transparency at what lies beyond, you are not seeing glass as remote history knew it. You are seeing a new glass, a magic product whose combination of beauty, transparency, and usefulness in a hundred ways, is of comparatively recent development.

From the Rome of the Caesars, the life-thread of glass winds its way haltingly to Asia through Byzantium . . . to Germany, France and England. It has a stout shoot leading off to Venice, in Italy, where glass became famous as the material used by Venetian artisans in making their beautiful vitric wares. And then, suddenly, the thread is lost again, broken by the intervention of the Dark Ages.

Centuries later, its dangling end comes to light once more. And it leads us again to Venice, to Bohemia, to England. We find glass used quite extensively in church and cathedral windows . . . but still as a decorative, art material, pretty to look at, admitting feeble light, it is true, but totally without the clarity and whiteness which we accept as commonplace in glass today.

However, as the centuries succeeded each other, the slender thread of glass history grew straighter and stouter, lengthened rapidly, became easier to follow. It led to many lands and many peoples. And finally, when the first colonists left England for Virginia, it came to America. Here, in the years that followed, it was snapped again and again, seemed irretrievably lost. Project after project, planned to make possible the production of glass in this country, failed dismally. Men gave their labors, their money, their health and their lives to the dream of glass. Yet misfortune dogged their steps. Their sacrifices came to nothing for long, bitter years. Foreign competition, shipping glass from abroad at prices American makers could not meet, throttled their hopes. Skilled workers in glass were few in this country. Transportation, considering the breakable nature of glass, was extremely difficult over the rough roads of the early America. And people had so little money that they bought no more glass than was necessary.

But the raw materials from which glass was made, were here in abundance. Gradually, a number of skilled glass artisans, trained in this country, were being developed. There was the need, even though small at first, for glass for the windows of the nation. And above all, there were men whose dream of successfully producing glass could not be thwarted even by constant failure and seemingly insurmountable obstacles.

And so, after decades of heroic struggle, success finally crowned the efforts of American glass makers. Five decades ago they began to produce glass of good quality . . . and at a profit. From that time on, there has been no interruption or breaking of the life-thread of glass. It has surged steadily, rapidly forward, until at last, it leads to the highest development of the glass-making art the world has ever seen . . . the modern miracle of polished plate glass as it is produced in our factories today.

MANUFACTURING METHODS

INTO THE FIERY *furnace go huge electric tongs, to grasp the pot of molten glass within, withdraw it, and carry it to the soaking pit where it is brought to exactly the proper condition for casting.*

THERE is one characteristic of its manufacture in which plate glass differs from all other types of flat glass . . . the fact that all plate glass is ground and polished. It gives absolutely true vision without distortion or interference. Its body is almost as clear as the open air itself and its surfaces are free from the familiar waves, swirls and curlicues which often mar sheet glass.

To meet the varied requirements of modern plate glass usage, many thicknesses and sizes of glass must be produced. There must be plate glass in lights many feet in length and width for huge store windows. There must be small pieces of plate glass to be fabricated into tiny mirrors. There must be plate glass an inch and a quarter thick to withstand hard knocks. And there must be plate glass only 7/64 of an inch thick for use in places where strength and weight are not so important. To manufacture these varying sizes and thicknesses, while maintaining a high and consistent standard of quality, has presented innumerable difficulties to the producers.

But today, there are two chief methods of plate glass manufacture which have been accepted by the industry as the best ways of producing quality glass for all purposes . . . the pot casting and the continuous methods. They are essentially alike, save for the preliminary processes involved, but the older of the two, the pot casting method, is used primarily for making plate glass of larger size and thickness, while the continuous method is generally employed for making plate glass of smaller size and thickness. To see these methods in actual operation is an experience never to be forgotten. Mere words cannot paint with adequate vividness the thrill and color and glamour of an actual inspection of a plate glass plant in operation. But words *can* present a practical explanation of what goes on in a glass factory . . . and with such a description of facts, aided by the photographs included in this booklet, we shall have to be content.

THE MATERIALS

BEFORE we enter into a detailed description of the two manufacturing methods mentioned above, let us examine for a moment the raw materials which go into the making of plate glass. The main ingredient is sand . . . white sand like the sand you see on bathing beaches and in children's sand boxes . . . except that it is finer in quality, carefully graded. With this sand is mixed limestone, soda ash, salt cake, arsenic, charcoal and common table salt in varying amounts. The final ingredient is cullet, or broken glass, enormous piles of which may be seen glistening in the sun around any glass plant. Together, these raw materials form the "batch" from which plate glass is made.

THE POT-CASTING METHOD

FROM THE MOUTH *of the furnace comes a glowing pot of liquid, white hot glass, ready to start on its journey toward cool, polished, transparent perfection.*

As indicated by its name, this method involves the use of huge pots or crucibles, in which the "batch" is melted in the furnaces. These pots are composed of fire clays, very carefully and scientifically conditioned to withstand the enormous heat they will later be subjected to in the furnaces. Until very recently, they had to be made entirely by hand . . . slowly, painstakingly . . . the pot maker building up his clay layer by layer with infinite care. Then the finished pot had to be dried slowly. Before it was ready for the work for which it was intended, years were often consumed . . . and then its span of useful life was less than a month. Today, however, these pots are made by a pouring process which greatly decreases the time consumed in their making, are dried by a specially developed drying apparatus, and result in the production of better and more uniform glass than the old hand-made pots.

The modern pot is produced like this: the kneaded clay of which the exterior pot shell is composed, is poured into a hollow form. Then a gigantic plunger is pressed into the hollow form on top of the clay. The clay is forced up around the sides of the plunger, resulting, when the plunger is removed, in a shell of clay deposited around the inside surface of the form. After this outer pot shell has dried to the proper consistency, an inner shell of finer clays is applied to it. Then the pot is run through a drying machine which, in the brief period of eight days, dries the clay uniformly. After emerging from the drier, the pot is allowed to set for ten or twelve days in a warm room. It is then ready for use . . . twenty days after completion, instead of the months formerly required by the old methods of pot making.

From the storage room where it awaits its call for service, the pot passes through a tunnel kiln, where it is gradually heated up to the temperature of the furnace it will have to enter. This preliminary heating serves as a test of the pot's resistance to heat, a final proving of its capacity to perform its job without breaking down, which, should it occur in the furnaces themselves when the pot is filled with molten glass, would prove disastrous.

Having been heated to furnace temperatures, the pot is then placed in the furnace . . . a roaring chamber of fire and heat where there is room for from twelve to twenty pots. Once in the furnace, the pot is loaded with "batch" . . . filled with the mixed raw materials which we have already enumerated. This filling of the pot is done by

HERE ARE THE *forming rolls which press molten glass into wide, flat sheets. The smaller roll may be seen in the center of the photograph, while the top curve of the 12 foot roll is visible in the lower right foreground.*

means of a long handled ladle, which, when filled with ingredients from hoppers above the furnace doors, is inserted through the furnace door and dumped into the pot within. During its 36 to 48 hours in the furnace, the pot must be refilled several times with "batch" as each potfull shrinks as it melts, and a full pot of molten glass is required at the end of each melting. During the melting of the ingredients, the maximum heat attained in the furnace is about 2635 degrees F.

At the end of the melting period, the furnace door is opened, a huge crane-operated pair of tongs glides into the furnace and comes out firmly grasping the pot full of molten glass. The pot is red hot and incandescent from the terrific furnace heat it has endured, and the molten glass or "metal" it contains is like a huge potfull of glowing, orange-red taffy, more beautiful in color and brilliance than any precious stone ever mined.

The electric tongs holding the pot are now pulled by the overhead crane from the furnace to another, smaller furnace called the soaking pit. The pot is placed in this soaking pit until the molten glass has been reheated to the proper temperature after its cool ride through the open plant from furnace to soaking pit.

The pot is moved from the soaking pit auto-

LIQUID GLASS, *pouring from the pot into the hopper between the forming rolls. Gradually this molten metal will be fed into the rolls to be compressed into a plate.*

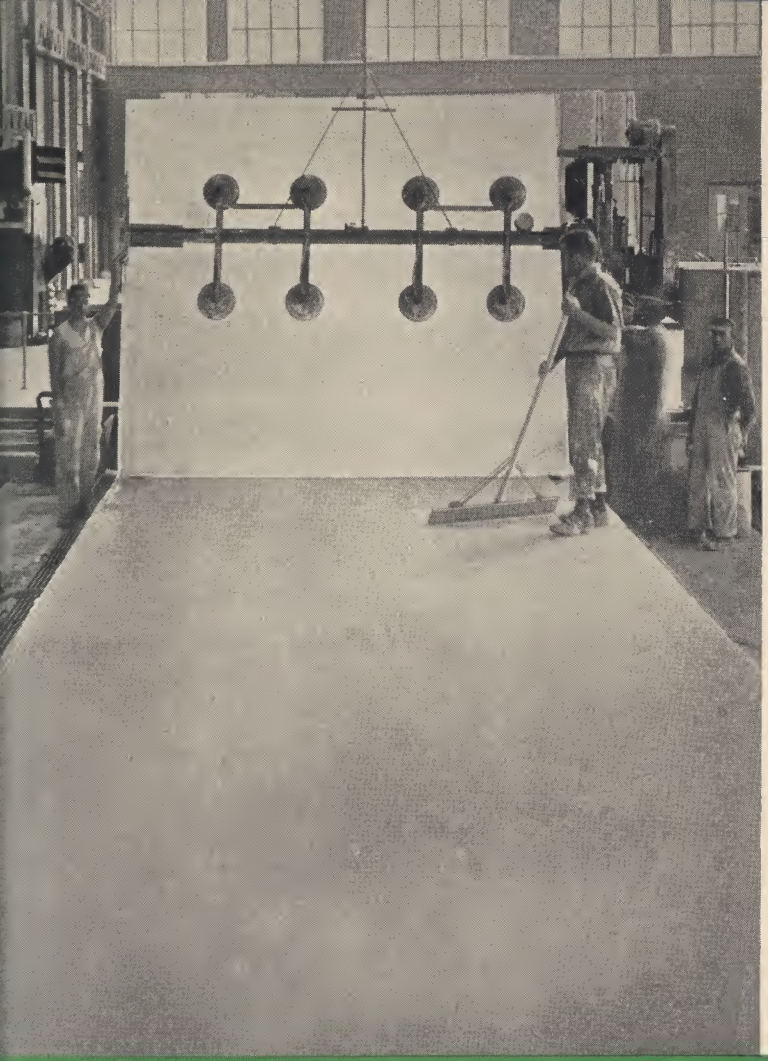
AS THE WIDE SHEET *of glass emerges from the annealing lehr, it is carefully inspected, then cut into sizes convenient for the grinding and polishing operations to follow.*

matically when the molten "metal" is exactly ready for casting. As it emerges, the pot is immediately cleaned of any dust, dirt or refuse it may have collected on its sides or bottom by automatic brushes and streams of compressed air. This is done so that no dirt can drop from the pot into the molten glass during the casting. The top surface of the molten glass, which has cooled somewhat, is then skimmed off quickly by men with long scoops, to assure uniform consistency of the "metal." And the giant tongs again grasp the pot. They lift it over the forming rolls, tilt it, and the molten glass pours out in a red hot cascade into the shallow hopper formed by the rolls. These forming rolls are like the rollers on a clothes wringer, except that they are very much bigger and longer. One of them is approximately 12 feet in diameter, the other approximately 28 inches. They revolve so that their surfaces move at the same rate of speed. The molten glass, usually cast at a temperature of 2000 to 2050 degrees, is fed between the rollers, and as it emerges from between them, becomes a wide, flat plate of glowing, hot glass. Its thickness is determined by the distance separating the rolls. The contents of one pot rolls out into a plate 800 inches long, if the rollers are set for glass 3/16 of an inch thick. In casting 1/4" glass, one pot of metal makes a sheet about 700 inches long.

From the casting rolls, the wide plate of hot glass passes on a slowly moving table into the annealing oven, or lehr. The purpose of this lehr is to cool the glass gradually, subjecting it to slowly decreasing temperatures, until, by the time it emerges, the glass is at room temperature, and so uniformly cooled that its quality has not been lowered by the internal strains which develop when hot glass is cooled suddenly or unevenly.

An annealing oven in a large plant is many hundreds of feet long, and the glass plate passes through it very slowly, consuming about an hour and three quarters in its journey. As it finishes its trip through the lehr, and comes once more into the light of day, it is cut into large sections by skilled workmen. But first, a careful inspection of its surface is made by men sitting in the very mouth of the lehr, and if any serious defects are discovered, that part of the plate is destroyed.

Having followed plate glass thus far in its manufacture, let's see what it looks like. It is not the clear, brilliant material we are used to thinking of when we say "plate glass." Instead, it is rough surfaced, almost opaque. The process is only half completed.



THIS MACHINE, *fitted with vacuum disks, lifts each sheet of rough glass from the conveyor to the grinding and polishing tables, and settles it into the plaster of Paris solution with which the tables have been coated.*

A BATTERY *of grinding machines, under which the rough sheet of glass passes. These grinding units, under tremendous pressure, rub sand and water over the surface of the glass, gradually smoothing it off, destroying irregularities.*

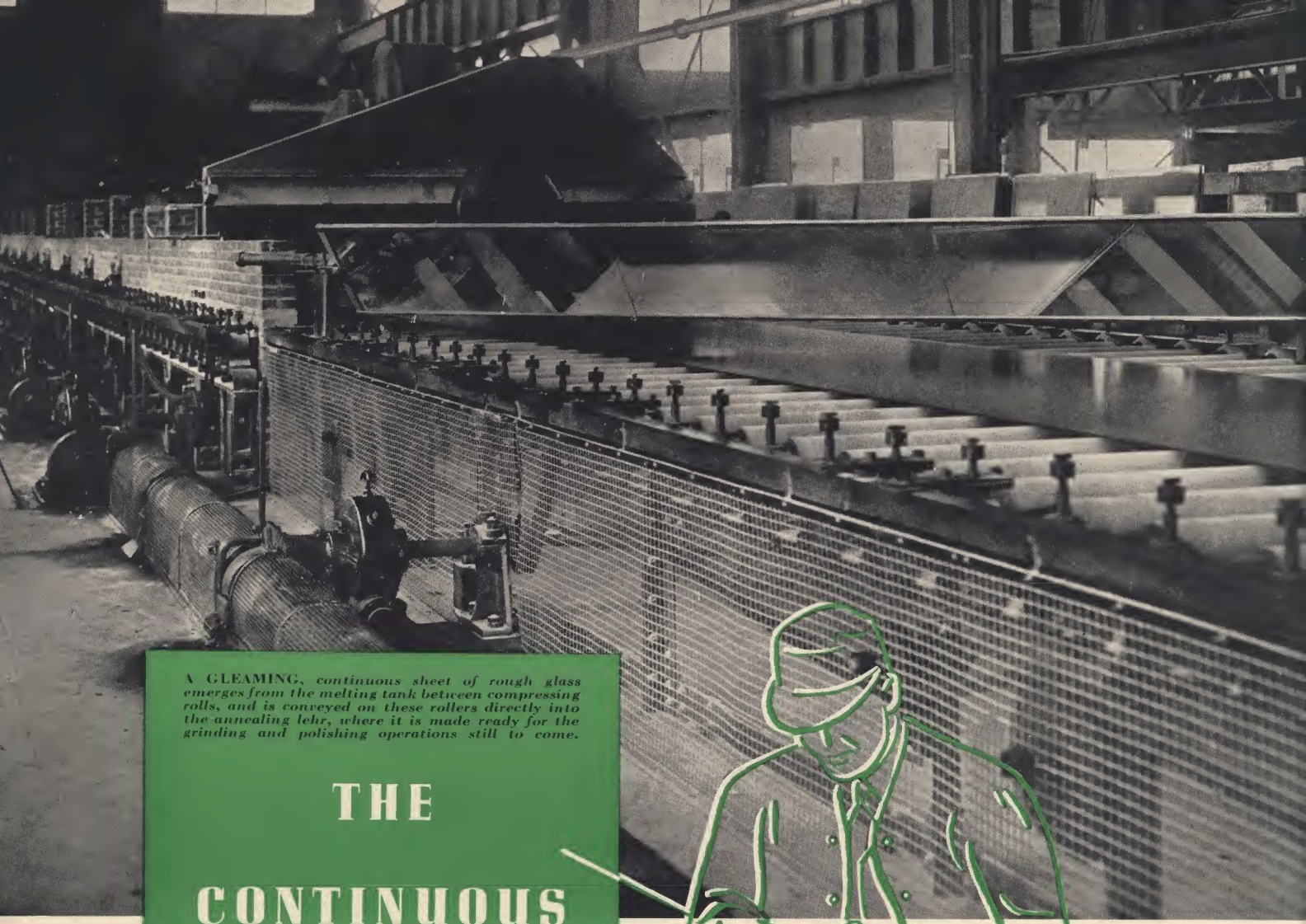
A moving belt takes the sections of rough glass to another part of the plant, where a crane, operating an enormous machine consisting of numerous rubber vacuum disks, lifts each section of glass in turn and lays it upon a moving table, which has been prepared to receive it with a thin coating of plaster of Paris solution. Once it has been placed on this plaster covered table, a heavy automatic roller descends and presses the glass firmly downward, imbedding it securely in the plaster. The table then moves slowly down the length of the tremendous building, passing in turn under a battery of grinding machines and then under a battery of polishers.

Each grinding machine consists of an enormous metal disk, shod with iron runners, which revolves at high speed over the surface of the glass. Between the grinding disk and the surface of the glass, sand is introduced mixed with water, as an abrasive. Under incredible pressure, the revolving grinder rubs the sand and water over the surface of the glass, gradually smoothing it off, and destroying its irregularities. And as the glass progresses from one grinder to another, the abrasive sand becomes finer and finer in texture until the last few grinders are fed with emery, a finer abrasive than sand, and this emery becomes finer and finer in quality until it looks of about the consistency of talcum powder.

By the time the last grinding machine has been passed, the glass is velvet smooth and uniform of surface, and ready for polishing. Polishing is done by similar revolving disks, but these disks are shod with thick felt pads instead of iron, and iron oxide or "rouge" as it is called from its bright red color, is used as a polishing agent. This material is the finest abrasive known.

Now one surface of the glass has been completed. It merely remains to repeat the grinding and polishing processes on the other surface. So the glass is loosened from its plaster of Paris bed, turned over, re-imbedded in plaster, and the grinders and polishers do their work a second time. And at last, we see the polished, beautiful, transparent plate glass we know.

The final finishing steps in the process are simple. The glass passes through a bath of muriatic acid to remove all traces of clinging plaster, and "rouge." It is then carefully inspected by highly skilled men to detect any imperfections or flaws. And finally, the large plates are marked and cut into desired sizes . . . and the glass is ready for shipment to the user.



A GLEAMING, *continuous sheet of rough glass emerges from the melting tank between compressing rolls, and is conveyed on these rollers directly into the annealing lehr, where it is made ready for the grinding and polishing operations still to come.*

THE CONTINUOUS METHOD

THE continuous method of plate glass manufacture differs only in its initial stages from the pot casting method. It is of more recent development than the pot casting method . . . and has reached its present eminent position in the field of plate glass production largely due to the great demand for plate glass created by the growth of the automobile industry. Plate glass in huge quantities was needed . . . very thin plate glass, perfect in every respect . . . to be laminated into the safety plate glass windshields and windows of modern automobile usage. It was found that plate glass to meet these needs . . . thinner glass, in smaller sizes . . . could be made more quickly and in greater volume by varying the old procedure.

Instead of employing individual pots and furnaces, the ingredients of the glass are melted in a single enormous furnace or tank, when the continuous method is used. This tank is approximately 120 feet in length. The "batch", already mixed in the "batch" house where the ingredients are kept, is brought to the mouth of the melting tank on endless moving belts. Here, at regular intervals, fresh quantities of ingredients are released and pushed automatically into the roaring interior of the white hot tank, where temperatures range from 2725 degrees to 2740 degrees F.

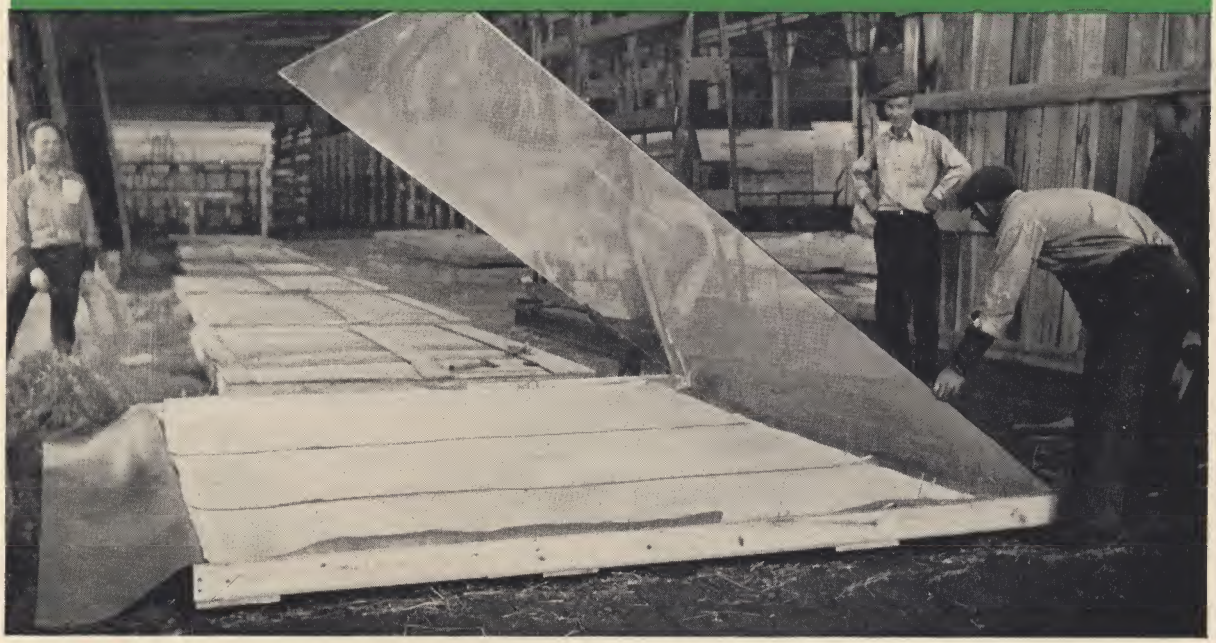
Loaded, the tank contains tons of molten glass, an enormous mass five feet deep. Every hour, the temperature inside the tank is checked by delicate instruments, kept exactly at the proper point for best melting.

The ingredients go in one end of the tank. They come out the other as molten glass, which flows, like sluggish molasses, between two water cooled rollers, each approximately 12 inches in diameter. As the molten "metal" passes between these rollers, it is compressed to the desired thickness, and flattened out into a broad even plate, just as the casting rolls flatten out the molten glass in the pot casting method. But where each potfull of "metal" forms a separate plate of hot glass in the pot casting method, the continuous method provides a continuous, unbroken ribbon of hot glass flowing out of the tank and through the lehr at approximately 142 inches a minute. Never for a moment, day or night, does this slowly moving ribbon stop, until the tank, after about a year of service, requires re-lining with new fire-clay blocks.

Once formed into a flat plate by the rolls at the end of the tank, the glass passes into an annealing oven, or lehr, just as in the pot casting method of manufacture. From that point on, the methods are exactly similar in every respect . cooling, cutting, grinding, polishing, washing and inspection.

AFTER BEING GROUND, *polished and washed, each sheet of finished plate glass is carefully inspected for flaws by experts. Lights are set behind the sheets, to bring out irregularities.*

HAVING PASSED *the rigid inspection, the finished polished plate glass is packed carefully in sturdy, specially built containers for shipment to all parts of the world.*



THE PICTURE WINDOW . . . *steadily gaining popularity in residences everywhere. Clear, generous in size, without cross sash to interfere with vision, the picture window adds charm both inside and out.*

PLATE GLASS

The Modern Miracle

THIS is how polished plate glass . . . one of the greatest of our modern miracles . . . comes into being.

How its use has spread in recent years, how it performs new and more wonderful services to mankind every day, how it adds beauty, comfort and pleasure to our living, are things which we need only look around us to discover.

In the building field, polished plate glass has carved a tremendously important place for itself. Walk down the main business street of any town or city, and see the large, polished expanses of plate glass which form the display windows of the stores, permitting perfect, undistorted viewing of the merchandise displayed, and yet providing protection from the elements and from thieves.

Glance at the thousands of residences,

MIRRORS MADE FROM *clear polished plate glass give new charm and color to this family fireside.*

AND HERE IS *a bedside table in the modern manner . . . entirely faced with bright mirror glass to introduce a note of gayety into the bedroom.*

office buildings, hotels, hospitals, clubs, theatres, laboratories, public buildings and edifices of all sorts, whose windows are glazed with polished plate glass for utility and beauty.

In modern houses, notice the increasing use of broad, high plate glass "picture windows" . . . without cross sash to interfere with vision . . . which build Nature's beauty, in all its lovely detail, right into the home.

See how areas of plate glass are being constantly increased in present day architectural design . . . to draw more light into rooms, to add to buildings' exterior beauty.

And glance at the widespread use of structural glass . . . an opaque variation of polished plate glass, beautifully colored, sturdy and strong . . . in store fronts, bathroom and kitchen walls, in the toilet rooms, corridors, lobbies and reception rooms of large buildings.

But great as the use of polished plate

AT LEFT, PLATE GLASS *enlivens the main streets of the nation. Store windows permit attractive, perfectly-seen displays of the merchandise with protection from the elements.*

AT LOWER LEFT, *a glass topped dressing table, not only chic, but very lovely, for the boudoir of the modern woman.*

BELOW, *a dining table given added charm and utility by a handsome plate glass top. Any meal becomes an occasion when served on this table.*

glass in building has become in recent years, its astonishing increase in importance in interior decoration has been even greater.

Today it is one of the decorator's most valuable and versatile tools, lending its beauty, transparency and utility for scores of fascinating and modern purposes. The use of plate glass mirrors will illustrate what we mean.

Mirrors, originally employed only as looking glasses for utilitarian purposes, are now decorative and ornamental media of the highest importance. Mirror paneling of

AT RIGHT, *a fireplace treatment of mirror glass panels which reflect the warmth, color and beauty of the whole room.*

BELOW AT RIGHT, *an illustration of another modern use of polished plate glass which is rapidly growing in favor . . . the decorative top for the occasional table.*

BELOW, *plate glass in one of the most important of its present day uses . . . safety glass . . . giving greater protection to automobile drivers and passengers against the hazards of flying, broken glass in emergencies.*

ROOMS DONE *in the modern manner sparkle and glow with plate glass. Here a mirror-paneled fireplace strikes the decorative note, with a plate glass table before the divan to give it accent.*

WHERE BEAUTY AND UTILITY *must be combined in commercial interiors, such as this beauty shop, polished plate glass mirrors answer the question admirably.*

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fireplaces, of walls, of furniture has become almost a commonplace. Framed and unframed mirrors of all types and colors now bring gayety and light into American homes. Mirrors are used for dressing table and dresser tops, for radiator covers, for window sills, for ornamental screens, for bookshelves, for cabinet doors, for a thousand purposes. And because only plate glass can give perfect, undistorted reflection, most of these mirrors are being fabricated from this material.

A LOVELY, *full-length plate glass mirror, flanked by good-looking and useful plate glass shelves, features this modern bathroom for the home of today.*

THE HOME *with windows of polished plate glass is a more lovely home, inside and out. Windows become more than mere openings in the walls when glazed with this modern material.*

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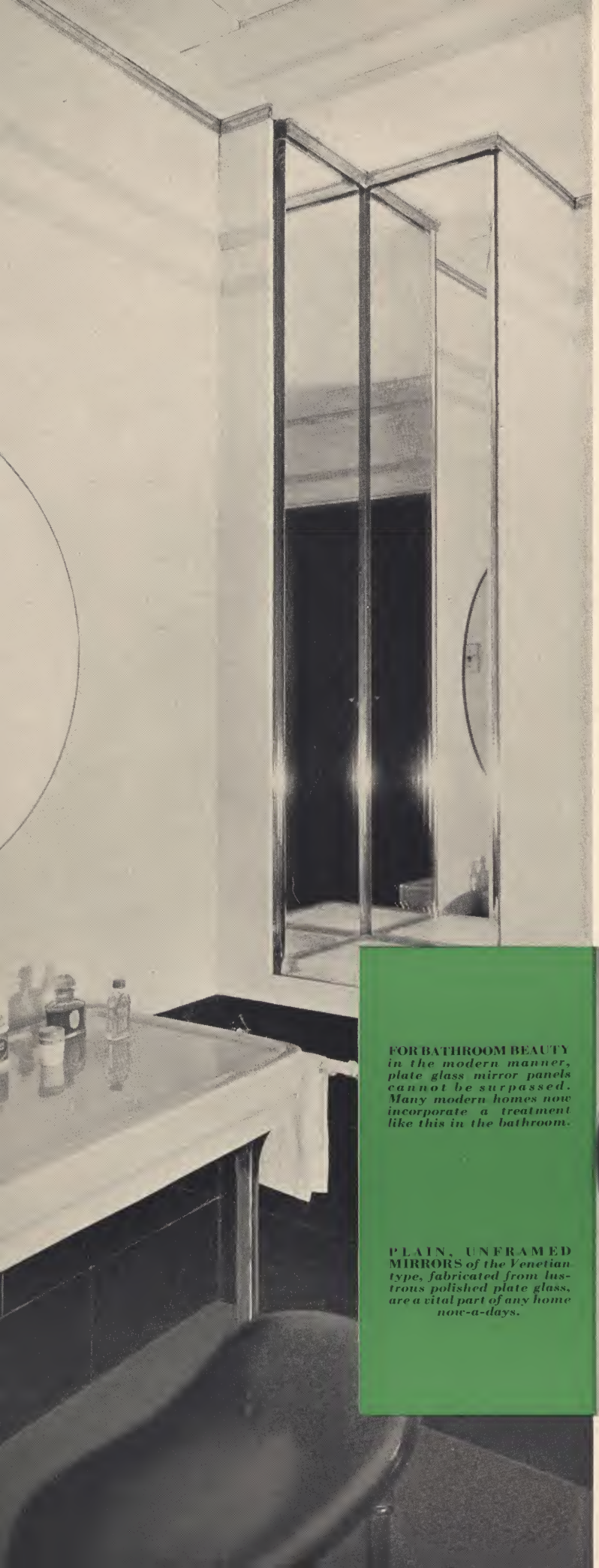
Then, when we realize that shower bath doors and enclosures, table tops, book shelves, furniture, partitions, picture coverings, show cases, book ends and a host of other things too numerous to mention are also being made today from polished plate glass, we get some idea of how this lovely material has penetrated into almost every sphere of gracious and useful living, how it has added to the beauty, usefulness and comfort of life.

As a final instance of the invaluable con-

tribution plate glass has made, let us look at the automobile. What would it be without the clear, brilliant windshield and windows of safety plate glass which not only defend the car's occupants from the elements and permit perfect vision of everything outside, but also afford such priceless additional protection against the hazards of broken, flying glass in emergencies?

No . . . there is no way to describe adequately what plate glass has meant to the

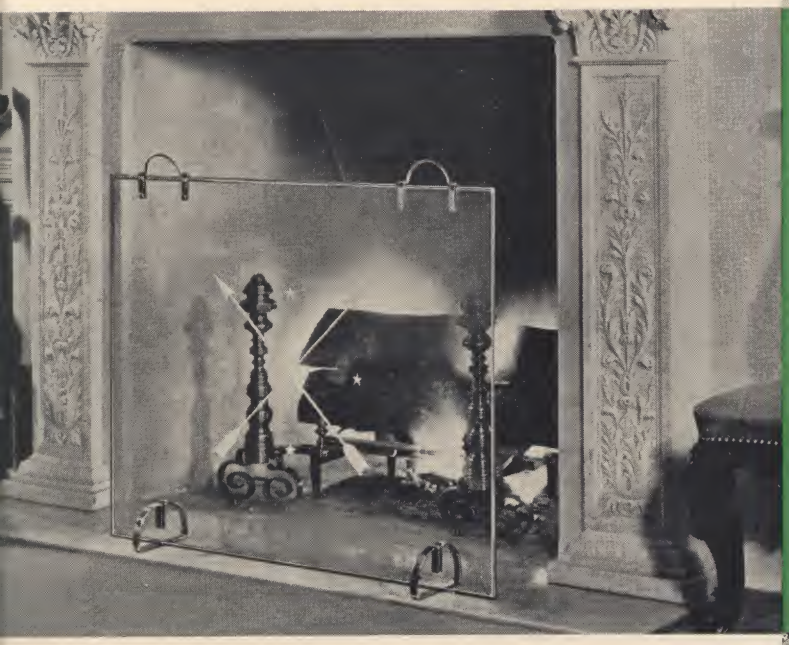


FOR BATHROOM BEAUTY *in the modern manner, plate glass mirror panels cannot be surpassed. Many modern homes now incorporate a treatment like this in the bathroom.*

PLAIN, UNFRAMED MIRRORS *of the Venetian type, fabricated from lustrous polished plate glass, are a vital part of any home now-a-days.*

development of the civilization of which we, as Americans, are so proud. And there is no apparent limit to the countless ways, still untried, in which plate glass will make even greater contributions to mankind's happiness, safety and comfort.

All we can do is be eternally grateful to the men of vision and determination who labored and died that we might enjoy the multitude of blessings made possible by polished plate glass . . . the modern miracle.



IN STORES, *homes, public buildings, the use of polished plate glass shelves increases daily. Shelves like this are far more beautiful than ordinary shelving . . . and are just as practical.*

POLISHED PLATE GLASS *which has been treated to a tempering process, so that it is heat resistant, can be used effectively for fire screens, as seen here.*

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